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Quantifying and Valuing the Wellbeing Impacts of Culture and Sport

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He has recently published guidelines on non-market valuation and subjective wellbeing for the UK Government, including an update to the HM Treasury Green Book manual. Daniel previously led on cost-benefit analysis at the Department for Work and Pensions and was senior economist at the Cabinet Office, where he won the 2012 John Hoy Prize in Economics for his work on evaluation methodology. He is currently scientific advisor to the SROI Network and works with a number of OECD governments and public sector organisations on policy evaluation.

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Amongst current professional roles, he is a member of the Office for National Statistics advisory forum on wellbeing (he recommended the questions for large scale surveys), on a National Academy of Sciences Panel on wellbeing in the US, and Chief Academic Advisor on Economic Appraisal to the Government Economic Service.

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This analysis was conducted using Understanding Society data supplied under the standard End User Licence (EUL) agreement from the Economic and Social Data Service (ESDS). Responsibility for the analysis and interpretation of these data are solely that of the authors.

Chapter 1: Introduction

1.1 Aims and objectives

The Department for Culture, Media and Sport (DCMS) commissioned researchers from the London School of Economics (LSE) to undertake analysis of Understanding Society data to develop the evidence base on the wellbeing impacts of cultural engagement and sport participation. This work gives us new evidence of the link between our policies and the social impacts of engagement in both sport and culture.

This report is the second of two outputs from the analysis carried out by the researchers. This report presents the results of an analysis of the association between culture, sport and measures of subjective wellbeing. This paper therefore looks at the perceived benefits for the individual using wellbeing valuation. The first report¹ presented an analysis of the association between culture and sport participation and a range of social outcomes. The first report therefore focused on cashable or financial benefits and savings of a range of social outcomes. Both are important aspects of the Green Book and policy evaluation.

The aims of the analysis presented within this report were to:

- Identify the impacts of culture and sport engagement on individuals' wellbeing.
- Estimate monetary values for those wellbeing impacts using the Wellbeing Valuation approach.

Each report presents background to the consideration of social and wellbeing impacts along with the key findings. The annexes contain the full papers and analysis produced by the authors from the LSE.

1.2 Background

When allocating scarce public resources, we would ideally like to know the costs and benefits of different allocating decisions. The costs are typically relatively easy to measure and value and there now exists a range of

¹ Quantifying the Social Impacts of Sport and Culture
(<https://www.gov.uk/government/publications/quantifying-the-social-impacts-of-sport-and-culture>)

established methods for providing estimates of the costs of a programme. It is the benefits that present the main challenge. So that we can determine whether or not an intervention creates a net benefit, we would ideally like to express benefits in monetary units thus allowing direct comparison with costs. In standard cost-benefit analysis, monetary values are estimated by making inferences about people's willingness to pay from market data or from asking them directly for their willingness to pay in a contingent valuation study. So, if we wanted to value engagement in culture and sports, we would typically look for market data and/or we could ask people hypothetical questions about their willingness to pay for particular activities and benefits.

These methods are not without their problems, however. Despite decades of research into improving the methods, some substantive challenges still remain. Revealed preferences are often not available and, where they are, it is often questionable whether they capture the true impact on 'utility' of a good or service. One of the main problems is that our preferences are often ill-informed and influenced heavily by context and sometimes by irrelevant cues and framing. Stated preference data suffer from the same challenges but are arguably compounded further by the hypothetical nature of a contingent valuation exercise.

An alternative approach to valuation which shows considerable promise and which is increasingly being used in the public policy context (Dolan & Fujiwara, 2012). The Wellbeing Valuation approach looks at the impact of a range of factors on subjective wellbeing (SWB) (see Fujiwara & Campbell, 2011 and the Green Book update 2011). If we also gather data on income, we can look at effect on SWB of a change in income alongside the effect of a policy intervention (or expected benefit from that intervention). In so doing, we are able to estimate the income required to bring about the same impact on SWB as the policy intervention, thus enabling us to express the benefits of the intervention in monetary units. So, if we wanted to value engagement in culture and sports, we can now look for the impact on subjective wellbeing that particular activities have and compare that to the impact from income.

It is worth saying that wellbeing measurement, quite apart from whether the impacts are subsequently valued for the purposes of economic appraisal, is an increasingly prominent part of policy discussions. The recent developments in monitoring national wellbeing in the UK, including large national surveys undertaken by the Office for National Statistics (ONS), have provided an important catalyst for this. Since May 2013 the ONS' annual reporting of national wellbeing has also included measures of cultural engagement and sports participation reflecting the significant role of DCMS' sectors in individual's wellbeing.

This analysis uses data from the Understanding Society survey, which is a large and representative sample of the UK population. With DCMS

engagement as a co-government funder of the Understanding Society study, the second wave of the survey contained information on a wealth of activities relating to engagement in sports and culture. The Wave 2 data released in January 2013 contained both the measures of sports and culture activities alongside subjective wellbeing measures. These data have never been analysed to show such activities' impact upon wellbeing and therefore provide a valuable opportunity to do so.

It is important to estimate causal relationships in this analysis so that we can single out the effects on SWB. The data available to us in this study are one wave of Understanding Society. The main difficulty in inferring causality from these data is that there may be a host of factors and attributes that people differ on in addition to the difference in engagement or participation status. To deal with the issue of causality in wellbeing models, we use an instrumental variable (IV) approach for income. We hold constant many of the potential differences between the groups that do and do not engage in the arts and sport, but we can never be sure that we have controlled for enough of the differences because we are reliant on having a good working theory of the possible confounding variables and available data on these variables. The statistical approach that we adopt is the best available given the nature of the data, and generally more rigorous than many previous studies which make no attempt to control for the possible confounding factors. Going forwards, we recommend the use of experimental methods to more conclusively establish causality (see discussion in Annex D).

A further report expanding this analysis to measure and value the impact of sport and culture on wider measures of social impact has been released separately.

Chapter 2: Summary of findings

Key Findings

Arts engagement

Arts engagement was found to be associated with higher wellbeing. This is valued at £1,084 per person per year, or £90 per person per month.

Library engagement

A significant association was also found between frequent library use and reported wellbeing. Using libraries frequently was valued at £1,359 per person per year for library users, or £113 per person per month.

Sport participation

Sport participation was also found to be associated with higher wellbeing. This increase is valued at £1,127 per person per year, or £94 per person per month.

Context

We identify statistically significant associations between cultural and sport engagement and individual wellbeing and a range of other social impacts. Holistic consideration of all identified impacts will help to build a broad narrative on the social impacts of culture and sport.

Although causal direction needs to be considered further, this analysis has controlled for a range of other determinants of SWB e.g. income, gender, health, region, marital status, employment status. This is the optimal statistical strategy for this kind of non-experimental data (where interventions have not been randomised) in order to identify cause and effect relationships and we control for all of the main determinants of SWB as set out in Fujiwara and Campbell (2011).

The analysis considered the extent to which culture and sport engagement is associated with wellbeing impacts once other determinants of wellbeing have been controlled for in regression analysis. The measure used in the analysis is self-reported life satisfaction.

Values have been calculated only for those wellbeing impacts identified as statistically significant. The values use a robust wellbeing valuation technique outlined within the HMT Green Book and that features in a number of high-profile academic publications. The derived values show

the increase in income that would be required to result in the same wellbeing increase.

In each case the monetary wellbeing value is based on individuals' own perceived value to themselves of engagement rather than a wider value to society. Any findings should also be considered in light of the wider social impacts in order to provide a more holistic consideration of the full non-economic impacts of culture and sport engagement as per guidelines in the HMT Green Book.

Annex A: Methodology

A.1. Background

The HM Treasury Green Book stipulates cost-benefit analysis (CBA) for the evaluation of public policies. The welfare economic theory of valuation that underpins CBA was developed by John Hicks and colleagues (Hicks and Allen, 1934). This states that the value of a good or service is subjective and should reflect the utility that people derive from it, where utility refers to the notion of underlying welfare or wellbeing. In other words, a monetary value should reflect the change in an individual's utility or wellbeing due to experiencing or consuming the good. In technical terms, value is measured as compensating surplus or equivalent surplus².

Compensating surplus (CS) is the amount of money, paid or received, that will leave the agent in his initial welfare position following a change in the (level of a) good³.

Equivalent Surplus (ES) is the amount of money, to be paid or received, that will leave the agent in his subsequent welfare position in absence of a change in the (level of a) good.

Traditionally, economists have sought to measure CS and ES by equating the satisfaction of preference with welfare. In order to estimate value where markets exist, economists have traced out demand curves for a good or used proxy markets where direct markets do not exist – for example the use of house prices to infer the value of environmental goods or amenities, such as good schools. These are known as **revealed preference valuation methods**. These markets do not always exist, however, and, even if they do, they may not work perfectly.

Economists have therefore further developed procedures to measure CS and ES by eliciting hypothetical choices in what is known as **stated preference valuation**. Contingent valuation is a frequently used stated preference method to value non-market goods, especially in the context of environmental litigation where suitable markets often do not exist. The

² Definitions from Bockstael and McConnell (1980).

³ Here, we use the general term 'good' to refer to any good, service or experience that we are looking to value.

method involves surveys in which respondents are asked how much they would pay for a given benefit.

Preference based valuation methods aim to measure people's willingness to pay (WTP) for a beneficial outcome or willingness to accept (WTA) a negative outcome and WTP and WTA can be linked back to CS and ES as follows:

Table 1. The relationship between Equivalent Surplus, Compensating Surplus, WTP and WTA

	Compensating Surplus	Equivalent Surplus
Welfare gain	<i>WTP for the positive change</i>	<i>WTA to forego the positive change</i>
Welfare loss	<i>WTA the negative change</i>	<i>WTP to avoid the negative change</i>

Many aspects of engagement in arts, culture and sports will not be traded in markets and hence we will not be able to infer the value that people place on these activities purely from their revealed behaviours. In many cases, we are likely to be reliant on stated preference methods and this methodology has been used with increasing frequency in the arts sector (e.g. Colombino & Nese, 2009). There are, however, many problems with preference-based approaches, not least of which is the assumption that people are able to forecast the impact of changed circumstances on their future lives and welfare – which they rarely can (see Dolan and Kahneman, 2008 and Fujiwara and Campbell, 2011 for in-depth discussions).

In this study, we use a relatively new method for non-market valuation: the **Wellbeing Valuation Approach**. Rather than relying on preferences to measure welfare, this method uses people's self-reports of their levels of wellbeing. As we show below, the Wellbeing Valuation (WV) approach can derive estimates of value that are fully consistent with the welfare economic theory of CS and ES and hence it is a valid alternative methodology to preference-based valuation methods.

The WV approach has been gaining popularity in the academic literature and is now a recognised methodology in the HM Treasury Green Book (see Fujiwara & Campbell, 2011 and the Green Book update 2011). Here we will assess the extent to which engagement in arts and sports impacts on people's subjective wellbeing and then place monetary values on these impacts.

The WV approach uses measures of subjective wellbeing (SWB), ideally from large national datasets. It is assumed that SWB represents a good proxy for an individual's welfare (or underlying 'utility' in the language of economics). By measuring welfare in this way, and running statistical analysis on the determinants of SWB, we are able to calculate the marginal rates of substitution between money and any other good. In

other words, **we can see how much money would be required to keep SWB constant in absence of the good**, which would equate to CS in this instance.

For example, if a 20% reduction in local crime rates increases the SWB of an individual by one index point and an increase in household income of £5,000 per year also increases SWB by one index point, then we would conclude that the 20% reduction in crime is worth £5,000 per year to them. In the present study, we will look at the impacts that engagement in arts and sports has on SWB and assess the amount of money that people could forego and still leave them at their initial level of welfare. This is the CS for engagement in arts and sport and is related to the notion of WTP, as shown in Table 1.

It is important to note, however, that **values derived using WV should not generally be seen as actual amounts that people would be willing to pay**. This is because we have not looked at people's preferences, which form the basis of purchasing decisions and market behaviour. This does not discredit the results derived from WV approach – they are simply values derived from a different theoretical measure of welfare and as we will show they are estimates of monetary value that are fully consistent with welfare economic theory (CS and ES).

Indeed, **given the many conceptual and methodological problems with a preference-based account of welfare, it can be argued that wellbeing valuation should be the preferred approach**. The derivations and calculations involved in estimating monetary values (CS and ES) using wellbeing valuation are set out in the Annex (section A.1).

There are a number of advantages in using the WV approach compared to preference-based valuation methods. First, we are not reliant on a proxy market to reveal a value as in the revealed preference method. Indeed, the WV approach can work in cases where proxy markets do not exist or where they are not in equilibrium.

It is possible to create markets in stated preference (contingent valuation) studies of course. There are, however, some well-known and pervasive biases inherent in contingent valuation. These include protest values, where respondents have a principled objection to providing a monetary value and strategic bias, where respondents seek to 'game' the study by providing values that they think will influence the final resource allocation decision.

One of the most serious problems with stated preferences is known as scope effects, where willingness to pay values are insensitive to the size of the good being valued, so that estimating a meaningful marginal rate of substitution between money and the good in question is impossible. As well as being insensitive to theoretical relevant factors, responses are also sensitive to theoretically irrelevant factors, such as the starting point and question order.

Finally, faith in stated preferences is shaken by the finding across many studies that we are guilty of ‘miswanting’; that is, of wanting things that do not make us feel better and not wanting things that would (Wilson and Gilbert, 2003). Economists have typically assumed, usually implicitly, that our preferences are a good guide to our subsequent experiences yet there is a **weak association between the strength of our desires and the impact on our lives from satisfying those preferences.**

In contrast, the wellbeing valuation method takes data from large national datasets, and so protest and strategic responses are not a problem. We allow regression analysis to tell us how important a factor is in someone’s life without asking them to attribute its value, and so scope effects are no longer an issue. Wellbeing responses can of course be heavily influenced by contextual factors that also influence willingness to pay responses (such as question order) but in large samples across many years we can better understand these effects, and control for them as required.

Significantly, the wellbeing valuation approach is based on real experiences and not, as in stated preference studies, on people’s imaginations of how they will be affected by a change. In the modelling, we look at how policy changes actually impact on people and their experiences of their lives and ascertain values based on these experiences, which will be a better reflection of the true impact than our imagination, which is a notoriously suspect guide to our future wellbeing.

A.2. Literature review

We have undertaken literature reviews in the past on culture and wellbeing, which can be found in Fujiwara (2013a⁴), and the CASE (forthcoming) programme also provides extensive overviews of the previous literature in this area. These are recent and extensive reviews of the literature and hence we did not feel that another review was warranted here. In general, a number of studies have found positive associations between engagement in culture and sports and wellbeing, as measured for example by life satisfaction.

The type of evidence used varies and includes qualitative survey evidence as well as quantitative methods that are better suited at assessing causal claims. **In general, there seem to be only a few studies that have used large national datasets as we do here.** Readers are directed to Fujiwara (2013a) and the work under the CASE (forthcoming) programme for detailed literature reviews.

⁴ Fujiwara (2013a). ‘Museums and Happiness: The Value of Participating in Museums and the Arts’. The Happy Museum Project and the Arts Council England.

A.3. Methodology

A.3.1. Data

In this study, we use two UK datasets. **Data on arts and sport engagement come from Wave 2 of *Understanding Society*** (2010-2011), which is a nationally representative sample of 40,000 households conducted annually in a panel format. Wave 2 of *Understanding Society* includes for the first time a wide variety of variables related to engagement in arts and sport, taken from the DCMS *Taking Part* survey. Hence we will use Wave 2 as a cross-sectional dataset in the analysis.

For reasons we shall discuss in more detail below, it is necessary to **estimate the impact of income (β_1 in equation (6) from Annex A.1) using data from the British Household Panel Survey (BHPS)**. This is not problematic because the BHPS is the predecessor to *Understanding Society* (*Understanding Society* contains more variables and a larger sample size) and it has now been merged in to the latter dataset, hence they are essentially the same nationally representative survey of the UK (but with much larger sample sizes in *Understanding Society*). We use the BHPS here because data on income are not as detailed in *Understanding Society* (discussed in detail below).

A.3.2. Estimation

In order to estimate the value of engagement in arts and sport, we need to estimate the impact that engagement and income have on SWB - in line with the wellbeing valuation literature we focus on life satisfaction as our measure of SWB (a discussion of the use of life satisfaction in this context can be found in Annex section A.1). These impacts on life satisfaction are respectively β_2 and β_1 in equation (6) from Annex section A.1 (and repeated below), which will allow us to derive the compensating surplus. This has traditionally been done using a single-equation model in regression analysis as in equation (7):

$$LS_i = \alpha + \beta_1 M_i + \beta_2 Q_i + \beta_3 X_i + \varepsilon_i \quad (7)$$

where the impact of income (β_1) and the non-market good (β_2) are taken from the same model. Fujiwara (2013b) shows that this single-equation method need not be the only approach; it would be possible to estimate the impact of income and the non-market good from two separate models, provided that the samples used were relatively similar across the two study sources, and input these results in equation (6) from Annex A.1:

$$CS = M^0 - e^{\left[\ln(M^0) - \frac{\beta_2}{\beta_1}\right]} \quad (6)$$

Indeed, there are advantages to doing so. The main technical issue involved in estimating equation (6) is that we have a robust estimate of the *causal effect* of income and the non-market good on life satisfaction. In other words, **we require unbiased estimates of β_1 and β_2** . This has been especially problematic for income. The income variable in life satisfaction models suffers from endogeneity due to reverse causality and selection effects and measurement error which all tend to lead to *downward* bias in the income coefficient in models like equation (7). Since the income coefficient acts as the denominator in the calculation of value in equation (6), this leads to an *upward bias* in the value of non-market goods using the WV method. As a result, we have seen implausibly high values for non-market goods in the WV literature in the past. For example, according to a study by Clark and Oswald (2002), the value of employment is about £20,000 per month in addition to wage income. Previous work using the WV approach for the CASE programme that used the BHPS to look at the value of going to the cinema, concerts and taking part in sports also derived very high values. For example, they estimated that going to the cinema at least once per week had a value of about £9,000 per year, which equates to more than £100 per visit. The evidence tends to suggest that happier people may be more likely to earn less or that there are important unobservable (to the econometrician) factors that cause people to earn less, whilst also helping them to be happy anyway⁵. This in addition to the downward bias created by measurement error in the income variable will lead to an underestimate of the impact of income on SWB.

The main difficulty in inferring causality from the available data is that there may be a host of factors and attributes that people differ on in addition to the difference in engagement or participation status. It may be these differences that drive changes in the outcomes we are interested in. In other words, using museum 'goers' as an example, we can see museum goers and non-goers in the data. Clearly, if we simply look at the group of people that go to museums compared to those that do not, then there are likely to be many differences between these groups. For example, the museum goers may be richer, more educated and less likely to have young children, and so the problem is that these attributes may be what is driving the differences in outcomes we see across the two groups. Certainly, if we were interested in life satisfaction we know that income impacts on life satisfaction and hence any positive association we may see between museum visits and life satisfaction could be due to income rather than any beneficial impact of museum visits on the individual.

The general strategy used in this paper has been to control for as many of the determinants of a given outcome as possible using

⁵ This is inferred from the fact that studies that have used instrumental variables for income in SWB models to solve for endogeneity and measurement error problems have tended to consistently find that the income coefficient increases (see Pischke, 2010 and Fujiwara and Campbell, 2011).

regression analysis. This methodology for causal inference is at least as robust as most research in this area (certainly, there are many studies that make no attempt to control for any differences across the two groups of interest). **It is the optimal method given the nature of the data and hence we believe that the results presented in this paper are informative for policy-making purposes.**

To further deal with the issue of causality in wellbeing models **we use an instrumental variable (IV) approach**, which eliminates the correlation between the error term and the income variable due to measurement error and/or endogeneity. A number of IVs for income have been proposed and employed in the SWB literature. These include spouse's income, industrial sector and spouse's education level (Pischke, 2010). These IVs are problematic as it is not clear that they satisfy the exclusion restriction and exogeneity criteria (especially the latter).

A more robust IV for income is lottery wins amongst lottery players, since by law they are random among lottery players and, by comparing small versus mid-sized lottery winners, we can assume that the exclusion restriction also holds. Lottery wins have been used in the SWB literature before by Lindahl (2002), Apouey and Clark (2009), Fujiwara (2013b) and Gardner and Oswald (2007) and here we closely follow Fujiwara (2013b). Understanding Society does not ask people about lottery wins, but we do have extensive data on lottery playing in the BHPS and hence use the BHPS dataset to estimate the causal impact of income on life satisfaction (β_1) in equation (6). The description of the methodology is set out in Annex section A.2.

We estimate the parameters needed to calculate CS in equation (6) in two separate models as follows:

Arts and sports model

$$LS_i = \alpha + \beta_1 M_i + \beta_2 Q_i + \beta_3 X_{1i} + \varepsilon_i \quad (8)$$

Two-stage least squares income model

$$LS_i = \pi + \beta_1^* \ln(M_i) + \beta_2 X_{2i} + \varepsilon_i \quad (9)$$

$$\ln(M_i) = \pi + \gamma Z_i + \vartheta_i \quad (10)$$

Equation (8) is estimated using Wave 2 of Understanding Society and equations (9) and (10) are estimated using the BHPS. Q_i is a vector of arts and sport engagement variables; X_{1i} is a vector of determinants of LS; X_{2i} is a vector of socioeconomic variables that are determinants of lottery playing frequency and Z_i is the lottery IV, which is a binary variable taking on a value of 1 if annual lottery wins are between £200 - £10,000 and a value of 0 if lottery wins are positive but under £200 per year (see Annex A.2).

Using equations (8) to (10), compensating surplus is estimated in a modified version of equation (6) as follows:

$$CS = M^0 - e^{\left[\ln(M^0) - \frac{\beta_2}{\beta_1^*}\right]} \quad (6^*)$$

where β_1^* depicts the more robust measure of the impact of income on life satisfaction from the 2SLS income model and β_2 is the coefficient on Q_i from equation (8).

In X_{1i} **we control for the main determinants of life satisfaction** as set out in Fujiwara and Campbell (2011):

- Household income
- Health status
- Marital status
- Employment status
- Social relationships
- Gender
- Children and dependents, including caring duties
- Age
- Housing
- Voluntary work
- Geographic region
- Personality traits (where possible)

We do not use education and religion which are often included in wellbeing regressions in the literature. Questions related to religion had low response rates in Understanding Society, which severely reduced sample sizes, jeopardising the models and education is usually found to have insignificant effects on wellbeing and is anyway arguably picked up (and covered to some extent) by variables on income and employment. The wellbeing literature has shown that personality traits explain a lot of the variation in individual wellbeing (DeNeve and Cooper, 1998) and so it is important to control for personality where possible as it may be an important confounding variable. There is a lack of data on personality in Understanding Society and we use whether the individual has home insurance as a measure of their risk preference.

Since we use different definitions and permutations of the arts and sports variables in equation (8), these cannot all be added in one single model due to multicollinearity and so we actually estimate a number of different versions of equation (8). We therefore run a total of six separate base models as follows.

1. Visits model (8.1)

Equation (8) where Q_i = [visited museums frequently, visited libraries frequently, visited heritage sites frequently]

2. Overall arts and sports model (8.2)

Equation (8) where Q_i = [all arts, all sports]

3. Sports model 1 (8.3)

Equation (8) where Q_i = [team sports, individual sports, all arts]

4. Sports model 2 (8.4)

Equation (8) where Q_i = [fitness, football, swimming, cycling, sports, all arts]

5. Arts model 1 (8.5)

Equation (8) where Q_i = [arts audience, arts participation, team sports, individual sports]

6. Arts model 2 (8.6)

Equation (8) where Q_i = [dance participation, drama participation, music participation, art participation, crafts participation, literature participation, film audience, exhibition audience, music audience, drama audience, dance audience team sports, individual sports]

All life satisfaction models are estimated using ordinary least squares (OLS), which assumes that the life satisfaction reporting scale (1 to 7) is cardinal. Ferrer-i-Carbonell and Frijters (2004) show that it makes little difference in wellbeing models whether one assumes cardinality or ordinality in the wellbeing variable and hence for ease of interpretation we use OLS (as is standard in much of the literature).

‘Global level’ sports variables are included in the arts models and ‘global level’ arts variables are included in the sports models in order to control for these variables when looking and sports and arts in depth. As discussed below, these modelling frameworks will be closely followed by the analysis in Part 2 on wider individual and social impacts. In addition we interact the sports and arts variables with gender, age, income level and region (all set as binary variables) to assess for heterogenous impacts⁶ by different population groups.

It should be noted that the engagement variables in Q_i can also suffer from similar biases to the income coefficient. We examined the Understanding Society dataset for potential natural experiments or IVs that would allow us to get robust estimates of the causal effect of engagement in arts and sport on SWB, but there were no clear candidates in the dataset. We therefore rely on regression analysis and a ‘selection on observables’ assumption to motivate the arts and sports model in equation (8), with the caveat that β_2 may be biased if, for example, certain people are more likely to engage in arts and sport and be happier or more satisfied with their lives anyway.

⁶ We call these ‘Distributional Impacts’ in this paper.

To maximise our ability to infer causality from these results we control for all the main determinants of life satisfaction in X_{1i} as possible given the data. The selection on observables assumption is the standard assumption employed in nearly all SWB studies to date and hence our arts and sports models in equation (8) are as robust as the large majority of published academic journal papers on the subject. Overall, for the Wellbeing Valuation task **our study is likely to be more robust due to the way we have estimated the income model.**

A main issue regarding the use of results from two separate models in estimating monetary value in equation (6*) is that samples from the different models need to be matched or at least be reasonably similar, which is of course something that comes naturally if the β coefficients in (7) come from the same regression model as in equation (6). The arts and sport model will be representative of respondents in Understanding Society, which is itself intended to be representative of the UK population. IV methods, however, do not use data on the whole survey sample (those with no missing values) as regression methods do. Instead, IV estimates are the causal effect for a generally unidentifiable complier (to the instrument) sub-group. The IV estimates the local average treatment effect for compliers to the instrument, or in our case for lottery wins it is the local average response function for income. Since we cannot observe who the compliers are here, we cannot say anything about the distribution of their background characteristics, which makes it hard to extrapolate results from our income model to other sample groups⁷.

As suggested by Apouey and Clark (2009), however, a large proportion of the UK population play lotteries (about 70%) and we look at small to medium-sized lottery winners, hence the results from our income model should be reasonably generalisable. Indeed, we find that when comparing differences in characteristics (such as age, income and educational background) between small to medium-sized lottery winners and the general population there are very few variables that are significantly different (statistically). If we assume that most lottery players in the BHPS are IV compliers⁸ then, **we can assume that the results from the income model (for the complier sub-group) and the arts and sport models are both representative of the UK population** - we will treat the causal estimate as the effect of income for the average person in the data sample - and hence they can be used in tandem in equation (6*) to estimate the compensating surplus⁹ of engagement in culture and sport.

⁷ It can, however, probably be assumed that there are no 'never-takers' in this IV set-up, which narrows down the external group to which we are extrapolating the LATE.

⁸ This is not an unreasonable assumption given that there are no 'defiers' (by standard IV assumptions) and no 'never-takers' in this lottery IV set up.

⁹ This is the same approach as that taken in Fujiwara (2013a).

A.3.3. Variable descriptions

In Understanding Society, all sports and cultural variables were asked for previous 12 months.

The “**team sports**” variable includes football (including 5/6 aside), rugby or American football, water sports (including yachting, sailing, canoeing, windsurfing, and waterskiing), basketball, netball, volleyball, cricket, hockey, baseball, softball, and rounders.

The “**individual sports**” variable includes health, fitness, gym or conditioning; gymnastics; swimming or diving; cycling, BMX, or mountain biking; track and field athletics, jogging, or running; hill trekking, backpacking, climbing, or mountaineering; golf; boxing; racquet sports like table tennis or squash; skiing; martial arts; and horse riding. Four sports variables were also analysed separately: health, fitness, gym, or conditioning; swimming or diving; cycling, BMX, or mountain biking; and football.

The **arts participation** variables are for dance, drama (singing to an audience, rehearsing or performing play or drama, or musician or dancer at a carnival), music (playing or writing), arts (painting, drawing, culture, photography, film, or using a computer for art), crafts (textiles, crafts, knitting, pottery, etc), and literature (reading, book club, or writing stories or poetry).

The **arts audience** variables are for watching a film, attending an exhibition (including video or electronic art, or street art), attending plays or dramas, attending a music performance event (including opera), and attending a dance event (including ballet, contemporary dance, and African dance).

The **museums/libraries/heritage sites visit** variables look at the frequency with which people visit museums or galleries/public libraries/heritage or historical sites in their own time over the past year.

The majority of the sample had engaged in sport (58.77%) or art activity (86.19%) in the last year, and a higher proportion of the sample had been an audience member at an art/cultural event (70.71%) than had participated in an art/cultural activity (25.12%).

Table 2: Proportion of respondents in each response category for variables where response options were “Yes” or “No”

Variable	% Yes	% No
Engaged in any sport	58.77	41.23
Engaged in any arts	86.19	13.81
Played any team sport	17.63	82.37
Played any individual sport	56.86	43.14
Did fitness	27.98	72.02
Played football	9.28	90.72
Did swimming	32.71	67.29
Did cycling	17.77	82.23
Was an audience member at any art event	70.71	29.29
Participated in any art event	25.12	74.88
Participated in any dance event	11.26	88.74
Participated in drama	8.31	91.69
Participated in music	10.44	89.56
Participated in arts	26.88	73.12
Participated in crafts	17.25	82.75
Participated in literature	65.31	34.69
Audience of a film	55.88	44.12
Audience at an exhibition	30.39	69.61
Audience at a play	34.33	65.67
Audience at a dance event	8.14	91.86

Descriptions of the explanatory variables used in the regression analyses can be found at the Annex section C.6.

Annex B: Full results

B.1. Life satisfaction models for culture and sports

Here we present the results for the culture and sports models in equations (8.1) through (8.6). In total, there are 13 models estimated (including the interaction models) and so to manage the presentation of results we show in Table 3 the main (summary) regression outputs (excluding the interaction terms models). The table presents coefficient sizes, standard errors, sample sizes and R-Squared values for all culture and sports variables from all of the models. The full outputs for all of the models can be found in Annex section C.3 and details of the robust checks/tests employed on the models can be found in Annex section C.4.

The following activities are positively and significantly associated with life satisfaction:

- **Engagement in sports**
- **Team sports and individual sports (for former effect is greatest)**
- **Swimming**
- **Engagement in arts (about the same impact as for sports)**
- **Attending the arts**
- **Participation in dance and crafts**
- **Attending musical events and plays**
- **Visiting libraries**

The following activities are negatively and significantly associated with life satisfaction:

- **Fitness (such as going to the gym)**
- **Performing music**

The aggregate variables (*All Sports, All Arts*) have larger coefficients than the coefficients of their constituent parts (i.e. *Team sports/Individual sports, All audience arts/All participation arts*), which may be due to a number of reasons, but the aggregate level variables will pick up interaction effects of the constituent parts and hence may be larger in magnitude. We should note that for the visits model sample sizes were substantially reduced due to a high rate of non-response to the libraries, museums and heritage sites questions (approximately 30,000 observations were lost). With more data, then, the positive

effects of visits to museums and heritage sites on life satisfaction may become statistically significant.

Table 3. The effect of culture and sport on life satisfaction (scale of 1-7)

Model & variables	Coefficient	S.E.	Sample size	R-Squared
Visits - Model (8.1)				
<i>Visit museums frequently</i>	0.014	(0.048)	6251	0.14
<i>Visit libraries frequently</i>	0.063**	(0.032)	6251	0.14
<i>Visit heritage sites frequently</i>	0.034	(0.036)	6251	0.14
Sports - Models (8.2)-(8.4)				
<i>All sports</i>	0.052***	(0.017)	36530	0.15
<i>Team sports</i>	0.052***	(0.020)	36530	0.15
<i>Individual sports</i>	0.038**	(0.017)	36530	0.15
<i>Fitness</i>	-0.058***	(0.016)	36530	0.15
<i>Football</i>	0.038	(0.026)	36530	0.15
<i>Swimming</i>	0.076***	(0.016)	36530	0.15
<i>Cycling</i>	0.028	(0.018)	36530	0.15
Culture - Models (8.5) & (8.6)				
<i>All arts</i>	0.050*	(0.027)	36531	0.15
<i>All audience arts</i>	0.043**	(0.020)	36531	0.15
<i>All participation arts</i>	0.030	(0.019)	36531	0.15
Audience				
<i>Film</i>	-0.008	(0.018)	36526	0.15
<i>Exhibitions</i>	-0.015	(0.017)	36526	0.15
<i>Music</i>	0.034**	(0.016)	36526	0.15
<i>Plays</i>	0.046***	(0.016)	36526	0.15
<i>Dance</i>	0.011	(0.025)	36526	0.15
Participation				
<i>Dance</i>	0.078***	(0.022)	36526	0.15
<i>Drama</i>	0.026	(0.026)	36526	0.15
<i>Music</i>	-0.055**	(0.023)	36526	0.15
<i>Art</i>	-0.016	(0.017)	36526	0.15
<i>Craft</i>	0.047**	(0.019)	36526	0.15
<i>Literature</i>	0.003	(0.017)	36526	0.15

Notes: *** 0.01 significance level, ** 0.05 significance level, * 0.10 significance level. S.E. = Standard errors (in parentheses). Results from cross-sectional OLS models.

B.2. Distributional impacts

We assess whether the impacts demonstrated in Table 3 differ across different population groups¹⁰ - for example whether the positive impact of sports is larger for men or women or for younger age groups. The large sample size in Understanding Society allows us to test whether impacts differ. We look at whether there are heterogeneous impacts of culture and sports by (i) gender; (ii) age; (iii) income level and (iv) region by interacting these variables with culture and sports. In order to balance samples in each group we set these demographic and socio-economic variables as binary variables determined by the sample median value as follows:

- Gender = male/female
- Age = >46/<47 (we split age around the median sample age of 46.6 years)
- Income group = >£2,868 gross household income pm/<£2,868 gross household income pm. This is a bit higher than the national average in 2010/2011 which was £2,425 (Office for National Statistics, 2013)
- Region = London/not London

and apply these interactions in Sports Model 1 and Arts Model 1. In other words, we look at the heterogeneous impacts of team sports, individual sports, arts audience and arts participation.

In general, we find very few significant interactive terms, implying that overall **there are few significant differences in the magnitudes of the impact of culture and sports on life satisfaction across different demographic and socio-economic groups.** There were no effects by gender or location. We only find there to be a differing effect by age for arts participation and for individual sports. When broken down, there is a larger positive effect on life satisfaction from individual sports for people over the age of 46. The same can also be said of arts participation: there is a larger positive effect on life satisfaction from arts participation for people over the age of 46. In line with the rest of the analysis here, the results may not have a full causal attribution due to the effect of unobserved factors that we cannot control for here (see the following discussion). Therefore, the reasons or factors driving these differences should be the basis of future research.

The results should be taken with some caveats and caution. As with any study using observational data and a selection on observables assumption (whereby differences in characteristics between participating and non-participating groups are assumed to be observable in the data and hence can be controlled for), we cannot fully claim

¹⁰ We have called this issue 'distributional impacts'. They are also known as heterogeneous impacts in the policy evaluation literature.

causality in these findings. It may be that the results are affected by reverse causality or that there are some unobserved confounding factors that are driving the relationships. For example, the negative relationship between life satisfaction and fitness and gym exercise might be due to people with lower life satisfaction in the first place 'selecting' into gym exercise - in other words, that people who feel bad about themselves (overweight, unfit etc.) may be more likely to go to the gym. In this case we would be wrong to conclude that fitness and gym exercise are bad for life satisfaction. A similar story could be said of the other negative relationship between playing music and life satisfaction – i.e., the sad musician. Likewise, the positive relationships we see may be being driven to some extent by unobservable factors such as personality traits.

Technically, in the current study the multivariate regression analyses derive *conditional associations* between engagement in culture and sport and wellbeing (or for Part 2 culture, sport and wider outcomes). They are associations conditional on controlling for a host of other factors that we believe confound the relationships and these associations will have a causal interpretation if the selection on observables assumption holds¹¹. In any event, and as discussed above, these are arguably the best methods available to us for this type of analysis given the data and since we have controlled for most of the main determinants of life satisfaction the results are clearly informative for policy purposes.

B.3. Two stage least squares income model (equations (9) and (10))

Table 4 in Annex A.5 shows the results of our 2SLS model for lottery wins. The second stage presents the income coefficient for our valuation model (6*). For reasons discussed, we control for gender, age, educational status and health, which are all associated with annual lottery win size, in order to ensure exogeneity in the lottery instrument in the first stage.

We find that log of annual household income increases life satisfaction by 1.16 and this is significant at the 5% level. This is based on a reasonably large sample of 10,334 lottery players. This can be interpreted as the *causal effect* of income on life satisfaction that does not suffer from issues related to endogeneity bias and measurement error and hence in equation (6*) we use $\beta_1^* = 1.16$ from Table 4b).

¹¹ There are other assumptions here too – such as correct functional form and correctly measured variables, although the selection on observables assumption is the substantive identifying assumption.

B.4. Monetary valuation of engagement in culture and sport

In this section we estimate monetary values (technically speaking compensating surplus) for all arts and sport related variables that were statistically significant in models (8.1) to (8.6) using the CS formula:

$$CS = M^0 - e^{\left[\ln(M^0) - \frac{\beta_2}{\beta_1^*}\right]} \quad (6^*)$$

where β_2 = coefficients on different arts and sports activities from models (8.1) to (8.6); $\beta_1^* = 1.16$ and $M^0 = \text{£}25,700$ (the sample average income).

We first use (6*) with the unbiased income coefficient estimated using lottery wins to recalculate some of the values from the previous CASE publication, which found high values for participation in cinema, concerts and sport. The CASE study used the BHPS and found that compared to never going/doing, going to the cinema at least once per week or doing sport at least once per week had a positive association with life satisfaction using the BHPS. We ignore concerts here as it was not significant at the 10% level in the original report. Table 5 shows the original coefficient estimates for sport and cinema and the CASE values in annual and weekly format. The values were based on an income coefficient estimate of 0.053 in the original paper. Using the coefficients in the second column as estimates of β_2 in equation (6*), together with our estimate of the income coefficient from 2SLS we derive significantly lower value estimates for these activities.

Table 5. Re-estimation of CASE programme results for sport and cinema visits

Variable	Coefficient	CASE Value (annual)	CASE Value (week)	Re-estimated (annual)	Re-estimated (week)
Sport (at least 1 pw)	0.025	£11,000	£212	£548	£10.54
Cinema (at least 1 pw)	0.019	£9,000	£173	£418	£8.04

We can make an informal test of the proposed methodology in this paper by looking at the value of cinema attendance because this activity is 'traded' in the market. The values in Table 5 are for people who go at least once per week, which is high, but let's assume here that on average these people go twice per week. This would give us a per cinema visit value of £86.50 from the CASE paper and £4.02 from our suggested methodology. Clearly the estimate of £4.02 seems more plausible and the value has been reduced considerably mainly due to the method applied here in estimating the effect of income on life satisfaction. The CASE programme work was based on best available methodology at the time, whereas the analysis here uses a different approach with lottery wins as an IV, which we believe is a more robust methodology. We note that the value should not equate to the price of a cinema ticket because the coefficient on cinema in Table 5 is *net* of the

cost of the visit because ticket prices are not controlled for in the model. In general, coefficients in life satisfaction models should be seen as the impact over and above the costs involved if these costs have not been controlled for - we discuss this in more detail below. So £4.02 is an estimate of the consumer surplus involved in cinema visits - it is the value people receive from a cinema trip over and above the price they pay to enter. The findings in Table 5 provide support for the methodology used in this paper since they make good sense in relation to market prices for a well-functioning market like cinema.

We note that (as we will see in Table 6) the value of doing sports is different when comparing the revised CASE results (£548 pa) and the results from the analysis of Understanding Society (£1,127 pa for all sports). This could be for a number of reasons. The main reason is likely to be that our '*All sports*' variable does not include all types of sport that are undertaken by people and that are reported in the Understanding Society survey. We narrowed down the list of sports categories to those that are most relevant and important to the present study and therefore the sports variable used in CASE study includes a wider variety of sports – hence we cannot make a like-for-like comparison. Second, although the BHPS data (used in the CASE study) and the Understanding Society data (used in this study) are both representative of the UK population, they come from different time periods and the impacts of sport on wellbeing may have changed over time, although in this paper we assume that this is not the case for the impact of income on life satisfaction and we do not have any hypotheses why this might be the case for sports and life satisfaction. We stipulate the difference in value estimates, therefore, to be due to the different sports variable definitions used across the two studies.

In Table 6 we present the valuation estimates from our analysis of the Understanding Society dataset, based on the impact estimates shown in Table 3.

Table 6 Value of engagement (per person) in culture and sports from Understanding Society

Model & variables	Coefficient	S.E.	Value (annual)	Value (monthly)
Visits (8.1)				
<i>Visit libraries frequently</i>	0.063**	(0.032)	£1,359	£113
Sports				
<i>All sports</i>	0.052***	(0.017)	£1,127	£94
<i>Team sports</i>	0.052***	(0.020)	£1,127	£94
<i>Individual sports</i>	0.038**	(0.017)	£828	£69
<i>Fitness</i>	-0.058***	(0.016)	-£1,318	-£110
<i>Swimming</i>	0.076***	(0.016)	£1,630	£136
Culture				
<i>All arts</i>	0.050*	(0.027)	£1,084	£90
<i>All audience arts</i>	0.043**	(0.020)	£935	£78
Audience				
<i>Music</i>	0.034**	(0.016)	£742	£62
<i>Plays</i>	0.046***	(0.016)	£999	£83
Participation				
<i>Dance</i>	0.078***	(0.022)	£1,671	£139
<i>Music</i>	-0.055**	(0.023)	-£1,248	-£104
<i>Craft</i>	0.047**	(0.019)	£1,020	£85

Notes: *** 0.01 significance level, ** 0.05 significance level, * 0.10 significance level. S.E. = Standard errors (in parentheses). Monetary values estimated as compensating surplus and derived for all variables significant at the 10% level. Monthly Values = Annual Values/12. Values in red for near-significant variables (at 10% level).

We estimate values for all variables that are significant at the 10% level, but we are most confident with values derived from variables significant at the 5% level. Ignoring the couple of negative values, values range from about £740 pa to £1,600 pa.

B.5. Interpretation and discussion of valuation results

We note that the values derived here are of a similar magnitude except for fitness and music participation which are negative values due to the negative coefficients derived in Table 3, the reasons for which we have discussed above: we shall ignore the results for fitness and music in the discussion here due to the complications surrounding causal inference for those variables. **Participation in dance has the highest value of £1,671 pa, followed by swimming (£1,630 pa) and library visits (£1,359 pa).**

The value estimates are plausible and seem reasonable for each activity type and this is due to the innovative methodology used to estimate the impact of income on life satisfaction in this study. The results are comparable to values estimated by Fujiwara (2013c) using the Taking

part dataset and the wellbeing valuation approach. Fujiwara (2013c) found that being audience to arts events has a value of about £2,000 pa and that participation in sports has a value of about £1,500 pa. These are higher than the values derived in Table 6 for a number of reasons. First, Fujiwara (2013c) uses happiness measured on a 10-point scale rather than life satisfaction. Since income is less strongly correlated with happiness than life satisfaction, we will tend to find larger monetary values estimates when using happiness instead of life satisfaction. Second, Taking Part is dataset representative of England rather than the UK and hence they are values for different sample groups. Taken together the results here and from Fujiwara (2013c) show that arts and sport are important determinants of wellbeing, whether measured using an evaluative global measure such as life satisfaction or a more affective or hedonic wellbeing measure such as happiness. Arts and sports activities are therefore valuable to the individual and this value will differ somewhat depending on whether we focus on happiness or more evaluative measures of wellbeing such as life satisfaction. The results here and from Fujiwara (2013c) support each other.

Unfortunately, the *Understanding Society* survey does not provide good data on the frequency with which the activities in Table 6 are undertaken and hence **it is hard to move from annual (or monthly) values to derive values on a per activity basis**. Ideally, we would like to know frequency of going among the subset of the population who do go. What we can glean from the data is that for people that do go (defined as people who go more than once per year) overall the median number of times people do arts audience activities is at least once per month. For moderate intensity sports, such as those in Table 6, the median frequency is one to three times per week. We can use these frequencies to break down the overall or aggregate level values from Table 6. Based on this data we will assume that overall arts audience activities are undertaken 15-20 times per year (as a conservative estimate). For the *All sports* variable we assume that the average frequency is 2 times per week or 104 times per year. Using these assumptions we estimate a 'per activity' value for the arts and sports.

Table 7. Value of engagement in culture and sports per activity

Model & variables	Coefficient	Average frequency (annual)	Value (annual)	Value per activity
Sports				
<i>All sports</i>	0.052***	104	£1,127	£10.84
Culture				
<i>All audience arts</i>	0.043**	15-20	£935	£46.75 - £62.33

This suggests that the value per sporting activity, such as playing football or going swimming, is about £11. For arts attendance, it is about £47 per activity (taking the conservative estimate). As discussed with the valuations for the CASE programme work, these are values in addition to any price paid to participate such as entrance fees. We stress that since the frequency data is poor in *Understanding Society*

and not directed at specific activities the per activity values derived in Table 7 are only indicative.

Finally, **we note that the values derived in this study (in Tables 5, 6 and 7) are measures of compensating surplus, which is the technical definition of monetary value used in CBA and the Green Book.** They are fully consistent with the theory of value set out in welfare economics and hence can be applied to CBA. As discussed above they should not be seen as measures of WTP or WTA – they are simply representations of the equivalent amount of money one would need to derive the same wellbeing impact that engaging in culture and sport has.

Annex C: Regression outputs

C.1. Derivation of the Wellbeing Valuation Approach

Formally, CS and ES can be measured as follows using the WV method. Using the indirect utility function CS for a non-market good, i.e. a good that has a positive effect on welfare, can be stated as follows:

$$v(p^0, Q^0, M^0) = v(p^1, Q^1, M^1 - CS) \quad (1)$$

where $v(\cdot)$ is the indirect utility function; M = income; Q = the good being valued; p = prices. The 0 superscript signifies the state before Q is consumed (or without the good) and the 1 superscript signifies the state after consumption (or with the good). In our analysis in this paper Q refers to engagement in arts and sport. In practice in WV using an 'observable' measure of welfare (ie, self-reported wellbeing rather than preferences) it is possible to estimate the marginal rate of substitution between M and Q to measure CS using the *direct utility function* $u(\cdot)$:

$$u(Q, M, X) \quad (2)$$

where X is a vector of other determinants of welfare (u). Empirically what we measure is:

$$LS(Q, M, X) \quad (3)$$

where LS = life satisfaction.

In other words, **we use life satisfaction as our measure of SWB.** Indeed, we could use any measure of SWB, such as happiness, in equation (3), but life satisfaction is preferred here since most of the WV literature to date has used this measure and there is good evidence to support the notion that life satisfaction can tell us something meaningful about people's wellbeing and how their lives are going. Life satisfaction has convergent validity: for example, Sandvik et al (1993) demonstrate that there is a strong positive correlation between life satisfaction and emotions such as smiling and frowning. Urry et al. (2004) show that reports of life satisfaction are correlated with activity in the left pre-frontal cortex of the brain, which is the area associated with sensations of positive emotions and pleasure. Furthermore, life satisfaction is a good predictor of health, such as heart disease, strokes and recovery from viruses and wounds (for more details see Fujiwara and Campbell, 2011). There is also evidence that life satisfaction has content validity.

Krueger and Schkade (2008) find that life satisfaction responses have sufficiently high retest reliability.

Equation (3) is usually estimated by applying regression analysis to panel or cross-sectional survey data to measure the impact of non-market goods on life satisfaction. Here we use one wave of Understanding Society and hence run the following life satisfaction function (assuming cross-sectional data):

$$LS_i = \alpha + \beta_1 M_i + \beta_2 Q_i + \beta_3 X_i + \varepsilon_i \quad (4)$$

Substituting equation (4) into (1):

$$LS_i(\alpha + \beta_1 M_i^0 + \beta_2 Q_i^0 + \beta_3 X_i^0 + \varepsilon_i) = (\alpha + \beta_1(M_i^1 - CS) + \beta_2 Q_i^1 + \beta_3 X_i^1 + \varepsilon_i) \quad (5)$$

and solving for CS gives us,

$$CS = M^0 - e^{\left[\ln(M^0) - \frac{\beta_2}{\beta_1}\right]} \quad (6)$$

Equation (6) is the derivation of compensating surplus using measures of SWB (here life satisfaction). It provides an estimate of the value people place on Q using the WV approach. Here M^0 is assumed to be sample average income and the term $e^{[\cdot]}$ accounts for the logarithmic format of the income variable in the income model, which was employed to account for the diminishing marginal utility of income.

C.2. Estimating the income model using lottery wins

The model for income uses the BHPS data on lottery wins as an instrumental variable in two stage least squares (2SLS) to provide exogenous changes in income. This means that we are able to run a model with fewer parametric restrictions that derives a causal estimate for income. A key benefit is that we control for only a few of the covariates, meaning that the indirect effects of income on wellbeing can mainly be accounted for in the model.

The reason for running 2SLS rather than a Wald estimate with no extra covariates is that we cannot observe the frequency of lottery playing in the BHPS. In the BHPS we know the total amount of annual lottery win size, but people that play lotteries more often are more likely to win and this is problematic if there are factors that make people more likely to play the lottery and which also impact on income as it will make the lottery win IV non-exogenous in the first stage. To circumvent this, we control for factors that are correlated with the likelihood of playing lotteries. This will help ensure exogeneity of the instrument in the first stage. 2SLS is run on the sample of lottery winners and we compare people with under £200 of annual winnings to those of with annual

lottery winnings between £200 - £10,000. This will help ensure the exclusion restriction in the second stage since both groups, $Z = 1$ and $Z = 0$ (where Z is the IV), have experienced winning on lotteries and hence the IV should only impact on life satisfaction through impacts on income. It was not possible to include engagement variables in the 2SLS model as only the Understanding Society data includes detailed questions on this.

C.3. Full regression output from OLS Life satisfaction models

Explanatory variable	Visits model (8.1)	Arts and sports model (8.2)	Sports model 1 (8.3)	Sports model 2 (8.4)	Arts model 1 (8.5)	Arts model 2 (8.6)
constant	3.671*** (0.309)	3.593*** (0.127)	3.580*** (0.127)	3.583*** (0.127)	3.596*** (0.126)	3.653*** (0.128)
log (household income)	0.132*** (0.029)	0.127*** (0.013)	0.126*** (0.013)	0.129*** (0.013)	0.124*** (0.013)	0.124*** (0.013)
Health	0.337*** (0.017)	0.401*** (0.008)	0.401*** (0.008)	0.403*** (0.008)	0.400*** (0.008)	0.400*** (0.008)
Gender	-0.127*** (0.035)	-0.066*** (0.016)	-0.073*** (0.016)	-0.071*** (0.017)	-0.070*** (0.016)	-0.049*** (0.017)
divorced	-0.006 (0.103)	-0.209*** (0.049)	-0.212*** (0.049)	-0.209*** (0.049)	-0.212*** (0.049)	-0.211*** (0.049)
Single	-0.249*** (0.074)	-0.123*** (0.030)	-0.124*** (0.030)	-0.119*** (0.030)	-0.125*** (0.030)	-0.125*** (0.030)
widowed	-0.368* (0.222)	-0.158** (0.067)	-0.162** (0.067)	-0.163** (0.067)	-0.159** (0.067)	-0.157** (0.067)
married	0.193*** (0.050)	0.168*** (0.022)	0.168*** (0.022)	0.167*** (0.022)	0.168*** (0.022)	0.169*** (0.022)
employed	0.013 (0.048)	0.123*** (0.021)	0.124*** (0.021)	0.126*** (0.021)	0.122*** (0.021)	0.123*** (0.021)
Retired	0.382*** (0.075)	0.462*** (0.035)	0.463*** (0.035)	0.465*** (0.035)	0.460*** (0.035)	0.462*** (0.035)
Friends	0.724***	0.516***	0.515***	0.515***	0.511***	0.513***

	(0.135)	(0.045)	(0.045)	(0.045)	(0.045)	(0.046)
children	-0.045** (0.020)	-0.040*** (0.010)	-0.039*** (0.010)	-0.041*** (0.010)	-0.038*** (0.010)	-0.037*** (0.010)
Age	-0.059*** (0.007)	-0.056*** (0.003)	-0.056*** (0.003)	-0.056*** (0.003)	-0.056*** (0.003)	-0.057*** (0.003)
age^2	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Carer	0.009 (0.043)	0.013 (0.022)	0.013 (0.022)	0.013 (0.022)	0.012 (0.022)	0.01 (0.022)
carer home	-0.229*** (0.070)	-0.186*** (0.028)	-0.186*** (0.028)	-0.187*** (0.028)	-0.184*** (0.028)	-0.182*** (0.028)
no. rooms	0.011 (0.010)	-0.001 (0.005)	-0.002 (0.005)	-0.001 (0.005)	-0.002 (0.005)	-0.003 (0.005)
volunteer	0.059* (0.032)	0.056*** (0.017)	0.053*** (0.017)	0.056*** (0.017)	0.049*** (0.017)	0.044** (0.018)
Insured	-0.017 (0.078)	-0.045 (0.031)	-0.045 (0.031)	-0.045 (0.031)	-0.046 (0.031)	-0.047 (0.031)
house owned	0.119** (0.058)	0.106*** (0.025)	0.106*** (0.025)	0.106*** (0.025)	0.106*** (0.025)	0.105*** (0.025)
local auth/housing assoc	0.028 (0.080)	-0.018 (0.031)	-0.018 (0.031)	-0.021 (0.031)	-0.015 (0.031)	-0.017 (0.031)
Wales	0.037 (0.064)	0.033 (0.027)	0.033 (0.027)	0.032 (0.027)	0.034 (0.027)	0.034 (0.027)
Scotland	0.089* (0.051)	0.005 (0.025)	0.005 (0.025)	0.006 (0.025)	0.005 (0.025)	0.005 (0.025)
N Ireland	0.065 (0.081)	-0.008 (0.029)	-0.008 (0.029)	-0.007 (0.029)	-0.006 (0.029)	-0.009 (0.029)
London	-0.074 (0.053)	-0.142*** (0.025)	-0.142*** (0.025)	-0.137*** (0.025)	-0.142*** (0.025)	-0.143*** (0.025)
museums frequently	0.014 (0.048)					

libraries frequently	0.063** (0.032)				
heritage frequently	0.034 (0.036)				
all arts		0.050* (0.027)			
all sports		0.052*** (0.017)			
team sports			0.052*** (0.020)		
individual sports			0.038** (0.017)		
Fitness				-0.058*** (0.016)	
football				0.038 (0.026)	
swimming				0.076*** (0.016)	
Cycling				0.028 (0.018)	
all audience arts					0.043** (0.020)
all participation arts					0.03 (0.019)
dance participation					0.078*** (0.022)
drama participation					0.026 (0.026)
music participation					-0.055** (0.023)
art participation					-0.016 (0.017)

craft participation						0.047** (0.019)
literature participation						0.003 (0.017)
film audience						-0.008 (0.018)
exhibition audience						-0.015 (0.017)
music audience						0.034** (0.016)
play audience						0.046*** (0.016)
dance audience						0.011 (0.025)
N	6251	36531	36531	36530	36531	36526
adj. R-sq	0.133	0.153	0.153	0.153	0.153	0.153

Notes: *** 0.01 significance level, ** 0.05 significance level, * 0.10 significance level. S.E. = Standard errors (in parentheses). Cross-sectional OLS regression models.

C.4. Diagnostic tests on life satisfaction models

The wellbeing models contain the main determinants of life satisfaction and have R-squared values of around 15% (all R-squared values were statistically significant under the standard F-tests), which is consistent with all the main research in this area. The evidence suggests that around 80% - 90% of the variation in SWB and life satisfaction is due to personality traits (DeNeve and Cooper, 1998) and so these (relatively small) R-squared values do not warrant any concern here. The direction and size of the impacts (coefficients) in the life satisfaction models were all in line with previous findings in the wellbeing literature. We run F-tests to check for the validity of adding culture and sports related variables to the underlying life satisfaction model. We test the restricted model, which is the life satisfaction model excluding the culture and sports variables against an unrestricted model, which includes culture and sports:

Restricted model: $LS_i = \alpha + \beta_1 M_i + \beta_2 X_{1i} + \varepsilon_i$

Unrestricted model: $LS_i = \alpha + \beta_1 M_i + \beta_2 X_i + \beta_3 Q_{1i} + \varepsilon_i$

We can reject the restricted model (that the β s for all culture and sports variables (here $\beta_3 = 0$) at the 1% level ($F_{0.01}(9, 36504) = 2.41$). We also find that the adjusted R-Squared increases in the unrestricted model. This signals that culture and sports help explain the variation in life satisfaction and hence these variables should be a part of the life satisfaction models.

In respect to the validity of inference and hypothesis testing, we checked the variance inflation factors (VIFs) in the models and found that no variable was troublesome - none were over the accepted threshold value of 4 (except for age and age-squared which is to be expected since they are functions of each other) and indeed the VIFs for all the arts and sports variables were around 1 indicating that there is no inflation of the standard errors for these variables. We employ heteroskedasticity-robust standard errors in all models.

C.5. Results from the income model

Table 4. 2SLS income model with lottery wins

4.a) First stage

Dependent variable: Log (household income)

Explanatory variable	Coefficient	SE
male	0.043***	(0.013)
health status	0.077***	(0.007)
low education	-0.288***	(0.013)
age	-0.002***	(0.0003)
lottery win	0.068***	(0.019)
constant	9.969***	(0.035)
Sample size	10334	

Notes: *** 0.01 significance level, ** 0.05 significance level, * 0.10 significance level. S.E. = Standard errors (in parentheses).

4.b) Second stage

Dependent variable: Life satisfaction (1-7)

Explanatory variable	Coefficient	SE
log (household income)	1.158**	(0.551)
male	-0.099***	(0.036)
health status	0.363***	(0.045)
low education	0.433***	(0.162)
age	0.011***	(0.001)
constant	-8.428	(5.503)
Sample size	10334	

Notes: *** 0.01 significance level, ** 0.05 significance level, * 0.10 significance level. S.E. = Standard errors (in parentheses). Household income instrumented with lottery win.

C.6. Descriptions of variables used in life satisfaction regression analyses

Variable	Description
<i>log (income)</i>	Log of equivalised household income
<i>health</i>	1 = if individual reports health to be 4 or 5 on 1-5 scale
<i>gender</i>	1 = male; 0 = female
<i>employed</i>	1 = employed; 0 = not working
<i>retired</i>	1 = retired; 0 = otherwise
<i>friends</i>	1 = if reports having friends; 0 = otherwise
<i>London</i>	1 = lives in London; 0 = otherwise
<i>Wales</i>	1 = lives in Wales; 0 = otherwise
<i>Scotland</i>	1 = lives in Scotland; 0 = otherwise
<i>N Ireland</i>	1 = lives in N. Ireland; 0 = otherwise
<i>no. rooms</i>	Number of rooms in the home
<i>children</i>	Number of children
<i>volunteer</i>	1= if volunteers; 0 = otherwise
<i>age</i>	age of individual
<i>married</i>	1 = married; 0 =otherwise
<i>divorced</i>	1 = divorced; 0 =otherwise
<i>widowed</i>	1 = widowed; 0 =otherwise
<i>carer home</i>	1 = if individual has caring duties; 0 = otherwise
<i>carer</i>	1 = if individual has caring duties at home; 0 = otherwise
<i>house owned</i>	1 = if owns home; 0 = otherwise
<i>local auth/housing assoc</i>	1 = if lives in local authority/housing association home; 0 = otherwise
<i>insured</i>	1 = has home insurance; 0 = otherwise
Culture & sports variables (all about last 12 months)	
<i>museums frequently</i>	1 = visit more than once per month; 0 =otherwise
<i>libraries frequently</i>	1 = visit more than once per month; 0 =otherwise
<i>heritage frequently</i>	1 = visit more than once per month; 0 =otherwise
<i>all arts</i>	1 = participated in / audience member of any arts below; 0 = otherwise
<i>all sports</i>	1 = participated in / audience member of any sports below; 0 = otherwise
<i>team sports</i>	1 = participated in football, rugby, water sports, basketball, netball, volleyball, cricket, hockey, or baseball, softball or rounders; 0 = otherwise
<i>individual sports</i>	1 = participated in health, fitness, gym or conditioning; gymnastics; swimming or diving; cycling, BMX or mountain biking; track and field athletics; jogging, cross-country, or road running; hill trekking, backpacking, climbing or mountaineering; golf; boxing; racquet sports; skiing; martial arts; or horse riding; 0 = otherwise
<i>fitness</i>	1 = did health, fitness, gym or conditioning; 0 = otherwise
<i>football</i>	1 = did football (inc 5 aside); 0 = otherwise
<i>swimming</i>	1 = did swimming / diving; 0 = otherwise
<i>cycling</i>	1 = did cycling, BMX or mountain biking; 0 = otherwise
<i>all audience arts</i>	1 = was a film, exhibition, music, play or dance audience member (see below); 0 = otherwise

<i>all participation arts</i>	1 = dance, drama, music, art, craft, or literature audience member (see below); 0 = otherwise
<i>dance participation</i>	1 = did dance, including ballet; 0 = otherwise
<i>drama participation</i>	1 = sang to audience; rehearsed/performed play/drama, opera/operetta or musical theatre; musician, dancer or costume maker at a carnival or street arts event; 0 = otherwise
<i>music participation</i>	1 = played a musical instrument or wrote music; 0 = otherwise
<i>art participation</i>	1 = did painting, drawing, printmaking or sculpture; photography, film or video-making; using a computer for original artworks or animation; 0 = otherwise
<i>craft participation</i>	1 = did textiles, wood crafts, or any other crafts such as embroidery, knitting, wood turning, furniture making, pottery or jewellery; 0 = otherwise
<i>literature participation</i>	1 = did reading for pleasure (not newspapers, magazines, or comics); was a member of a book club; wrote stories, plays, or poetry; 0 = otherwise
<i>film audience</i>	1 = watched a film at the cinema or other venue; 0 = otherwise
<i>exhibition audience</i>	1 = went to an exhibition of art, photography, sculpture or craft; streets art or a public art display or installation; 0 = otherwise
<i>music audience</i>	1 = went to an opera/operetta; classical music performance; rock, pop or jazz performance; 0 = otherwise
<i>play audience</i>	1 = went to a play/drama, pantomime, or musical; 0 = otherwise
<i>dance audience</i>	1 = went to a ballet; contemporary dance; African people's dance or South Asian and Chinese dance; or contemporary dance; 0 = otherwise

Annex D: Further research

Going forward, research in this area should aim to more conclusively address the issue of causality. Longitudinal data (either from subsequent waves of Understanding Society or from the new element of the Taking Part survey) are useful as we can control for some unobservable factors (those factors that do not change over time) through use of fixed effects regression analysis. Longitudinal data should not be seen as a panacea for the question of causality, however, because they cannot solve for the effect of unobservable factors that are not constant over time (such as people's preferences), which means that we still may not be able to attribute causality fully.

In order to conclusively address direction of causality issues, further work of the following type would be recommended. **Experimental methods** - whereby engagement in culture and sport is randomly assigned - will allow us to single out the effects of engagement and participation, although this may be difficult in practice due to non-compliance. However, this can be overcome somewhat by use of methods that randomise *encouragement to participate* in sporting and cultural activities instead - this might be through the provision of vouchers for free entry in to exhibits, art classes or sporting events. Encouragement designs allow people to ultimately decide whether they want to participate or not and they have been conducted to test the effect of adult learning on job outcomes in Switzerland (Schwerdt et al, 2012) for example.

Alternatively robust causal estimates can also be derived from **regression discontinuity design (RDD) methods**, whereby eligibility to participate in cultural and sporting activities is based on a single (pre-determined) observable criterion, such as frequency of engagement in the previous month or level of household income and here the intervention can be targeted at those groups in need or that are disadvantaged.

Annex E: References

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